

REMARKS

By the foregoing amendment, claims 1 and 2 are amended, and new claims 21-26 have been added.

Claim 1 is amended to recite details relating to the air gap solvent gas concentration. The lower limit of 470 ppm finds support in Table 1 and the upper limit of 1000 ppm finds support in the last paragraph of page 23 of the specification.

Claim 1 is also amended to recite an air gap relative humidity of 70% to 95%. This amendment finds support in the last paragraph on page 21 of the specification.

Claim 1 is further amended to incorporate an element previously recited as element (b) of claim 2.

New claims 21-26 are identical to claims previously presented, except that they have been amended to depend from different claims.

Claim Rejections – 35 U.S.C. § 112, Second Paragraph

The Action rejects claims 1, 2, and 6-9 under 35 U.S.C. § 112, second paragraph, as allegedly indefinite for reciting “K90.” In response, Applicants have amended claim 1 to remove the reference to the allegedly objectionable term, and respectfully request withdrawal of the rejection.

Claim Rejections under 35 U.S.C. § 103(a)

The Office Action rejects claims 1, 2, 6, and 7 under 35 U.S.C. § 103(a) as allegedly unpatentable over Kim et al. (WO2002/087735; as presented by U.S. Patent Application Publication No. 2004/0167237 A1 to Kim et al.) in view of Kozawa et al. (U.S. Patent No. 6,355,730). The Action rejects claims 8 and 9 over Kim et al. in view of Kozawa et al., and further in view of Carlsen et al. (U.S. Patent Re. No. 36,914). Applicants respectfully disagree with the rejections and submit that the present claims are patentable over the art of record, for at least the following reasons.

Claim 1 recites, "A hollow fiber membrane for blood purification obtained by running a raw spinning solution comprising polysulfone-based resin, polyvinylpyrrolidone, and dimethyl acetamide, through an air gap whose solvent gas concentration is 470 ppm or more and 1,000 or less and whose relative humidity is 70% to 95% for 0.4 seconds or more, the hollow fiber membrane having an integrally continuous structure from the inner membrane surface to the outer membrane surface and comprising a hydrophobic polymer and a hydrophilic polymer, an albumin sieving coefficient of 0.6% or less in a filtrate test using bovine serum, and exhibiting a zeta potential on the inner surface thereof of greater than -3.0 mV but less than 0 mV at pH 7.5, when measured using a sample with an embedded resin on the outer side for allowing the electrolyte solution to flow through only the inside of the hollow fiber, and using a 0.001 mol/l potassium chloride aqueous solution as an electrolyte solution." Applicants respectfully submit that this hollow fiber membrane is structurally different from, and non-obvious over, those membranes in the cited art.

Initially, Applicants note that an albumin sieving coefficient of 0.6% or less is exhibited when the solvent concentration in the air gap is 470 ppm or more. (See Table 1 and 2.) On the other hand, Examples 3, 5, and 6, and Comparative Example 3, which have the solvent concentration in the air gap at a lower concentration, exhibit an albumin sieving coefficient of greater than 0.6%. (Table 1 and 2.) Thus, the solvent concentration in the air gap results in a material difference in the structure of the end product, and of its performance.

Applicants submit that a solvent concentration of 470 ppm or more and 1000 ppm or less in the air gap produces a product that is materially different from, and not obvious over, the product of Kim et al. In Kim et al., the solvent gas concentration in the hood was not controlled to a particular concentration ("saturated with water vapor"; Comparative Example 1). In Example 6 of the present specification, dimethylacetamide (solvent, "DMAC") gas was not introduced and the DMAC gas concentration in the gap was controlled to 90 ppm, and relative humidity was 95% as in Example 1. Based on these points, Example 6 from the present specification is comparable to Comparative Example 1 of Kim et al. As noted above, the albumin sieving coefficient of Example 6 is higher than that of Examples 1, 2, 7, and 8, whose solvent gas concentration is set at 470 ppm or more, and more importantly, is outside the present

claims, which require an albumin sieving coefficient of 0.6% or less. Thus, Applicants respectfully submit that the recited solvent air gap concentration of 470 ppm or more and 1000 ppm or less, and an albumin sieving coefficient of 0.6% or less, is not taught or suggested by Kim et al.

Applicants further note that additional structural differences are produced in the membrane end product by the recited solvent air gap concentration of 470 ppm or more and 1000 ppm or less. Applicants respectfully direct the Office's attention to paragraphs [0079] – [0082] of the published version of the present specification, 2007/0080108, which are reproduced herein, with emphasis added, for the Office's convenience:

[0079] Although the method for producing a hollow fiber membrane with a controlled zeta potential on the inner surface of the membrane is as described above, in order to obtain a hollow fiber membrane which can more effectively ameliorate a long-term dialysis complication, it is important to increase the capability of fractionating into low-molecular-weight proteins and albumin, for example. According to the finding of the present inventors, in order to produce a hollow fiber membrane with excellent fractionability so that a PVP sieving coefficient is 45% or more and an albumin sieving coefficient is 0.6% or less, the pore size of the hollow fiber membrane before drying (in a wet state) must be reduced. This is because the inadequate structural change which a hollow fiber membrane in a wet state undergoes by drying leads to leakage of albumin from the hollow fiber membrane. Therefore, the PVP sieving coefficient of the hollow fiber membrane before drying is preferably 95% or less, and more preferably 90% or less. In this manner, the structural change before and after drying of the hollow fiber membrane, in other words, the structural shrinkage occurring when the membrane in a wet state is dried, must be controlled to the minimum. To this end, in addition to a later-described method, a method of increasing breaking strength and breaking elongation of the hollow fiber membrane by retarding the spinning speed or increasing the polymer concentration of the raw spinning solution can be given.

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[0081] Another important factor for reducing the structural shrinkage is the solvent (DMAC) gas concentration in the air gap. The structure of the hollow fiber membrane is formed by phase separation during running in the air gap after being extruded from the spinnerets. It has been newly found that the structure formation is greatly affected by not only temperature and humidity, but also by the solvent gas concentration in the air gap. If the solvent gas concentration in the air gap is small, the structural shrinkage tends to increase. This tendency is

remarkably noted when the air of which the temperature and humidity are controlled by an air processor or the like is introduced into the air gap. Although the reason for this phenomenon is not clear, promoted vaporization of the solvent from the outside surface of the fiber in the air gap allows the fiber with a high polymer concentration on the outer surface to enter the coagulation bath, which is thought to increase a shrinkage force.

[0082] On the other hand, in the case in which a solvent gas is introduced into the air gap, the structural shrinkage reduces. The reason is thought to be because an increased thickness of the gas diffusion layer near the outer surface of the fiber reduces the amount of the solvent gas vaporized from the fiber, which reduces shrinkage in the coagulation bath. An optimal solvent gas concentration in the air gap is 150 ppm or more and 1,000 ppm or less. It is difficult to inhibit the structural shrinkage if the concentration is less than 150 ppm; whereas a concentration of 1,000 ppm or more worsens the working environment and has a problem of providing a non-coagulated outer surface of the fiber. The solvent gas concentration can be measured using a gas-detecting tube, gas detector, gas chromatography, and the like. Measurement using a gas-detecting tube is easy and preferable.

Thus, as can be seen in these passages, the ideal membrane for dialysis filtration has an albumin sieving coefficient of 0.6% or less. In order to set the albumin sieving coefficient at 0.6% or less, Applicants realized that the structural change before and after drying of the hollow fiber membrane, in other words, the structural shrinkage occurring when the membrane in a wet state is dried, must be kept to a minimum. Applicants have also discovered that the structure formation is greatly affected not only by temperature and humidity, but also by the solvent gas concentration in the air gap, and that an optimal solvent gas concentration in the air gap is 150 ppm or more and 1,000 ppm or less. Applicants respectfully submit that the claimed solvent gas concentration in the air gap is 470 ppm or more and 1,000 ppm or less is even more ideal.

Applicants respectfully submit that Kim et al., Kozawa et al., and Carlsen et al., all fail to recognize what Applicants have discovered, which is the importance of minimizing structural change before and after drying, and thus, fail to suggest any modifications that would lead to the presently claimed invention. More particularly, Applicants submit that Kim et al., Kozawa et al., and Carlsen et al. all fail to teach or suggest the presently claimed, including, in particular, a hollow fiber membrane for blood purification obtained by running a raw spinning solution comprising polysulfone-based resin, polyvinylpyrrolidone, and dimethyl acetamide, through an air gap whose solvent gas concentration is 470 ppm or more and 1,000 or less. There is simply

nothing, in any of these documents – alone or in combination – that would teach or suggest this element of Applicants' claimed invention, let alone all of the other recited elements.


In view of the foregoing remarks and amendments, Applicants respectfully request withdrawal of the obviousness rejections.

CONCLUSION

In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejections of record, and allow all the pending claims.

Should there be any questions, the Examiner is invited to contact the undersigned at the below listed telephone number.

Respectfully submitted,
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June 26, 2009
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